Bonneagar Iompair Éireann
Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report 2024

Appendix A11.2: Generic Qualitative Risk Assessment Report

BARRY TRANSPORTATION
egis GROUP
egis

Project Ireland 2040
Building Ireland's Future

Luas Finglas Rail Project

Generic Quantitative Risk Assessment

GAVIN AND DOHERTY GEOSOLUTIONS LTD
UNIT 2A NUTGROVE OFFICE PARK,
RATHFARNHAM, DUBLIN 14, D14 X627 IRELAND
Tel: +353 1 207 1000 | www.gdgeo.com

Project Title:	Luas Finglas Rail Project
Report Title:	Generic Quantitative Risk Assessment
Document reference:	21075-R-001-01

Client:	J B Barry and Partners
Confidentiality:	This report remains the property of Gavin & Doherty Geosolutions and can only be published with prior written
Essential Requirements:	Document best viewed in colour

Document Control

Revision	Date	Authored:	Checked:	Approved:
00	28/02/2022	Erin Cline	Ruadh McIntosh	Brian McMeekin
Revision	**Date**	**Authored:**	**Checked:**	**Approved:**
01	01/04/2022	Erin Cline	Ruadh McIntosh	Brian McMeekin
Revision	**Date**	**Authored:**	**Checked:**	**Approved:**
Revision	**Date**	**Authored:**	**Checked:**	**Approved:**

Guidelines of use of report:

This report (hereafter the "Services") was prepared by Gavin & Doherty Geosolutions Ltd. (GDG) for **J B Barry and Partners** (hereafter the "Client") in accordance with the terms of a contract between **J B Barry and Partners** and GDG. GDG performed the services with the skill and care ordinarily exercised by a reasonable geotechnical civil engineering specialist at the time the services were performed. The Services were performed by GDG taking into account the limits of the scope of works required by the Client, the time scale involved, and the resources agreed between **J B Barry and Partners** and GDG. Third parties using any information contained within this report do so at their own risk. The design decisions in this report and related comments expressed herein are based on the information received, the conditions recorded during site investigation works, and on the results of tests made in the field and laboratory. However, there may be conditions existing at the site which have not been disclosed by the investigation available and which have not been taken into account in the report.

GDG provide no other representation or warranty whether express or implied, in relation to the Services expressly contained in the paragraph above.

This report should not be used for any other purposes apart from those expressly stated in this document.

Table of Contents

1 Introduction

1.1 Description of the Project

Gavin & Doherty Geosolutions have been requested by J B Barry and Partners to undertake a review and screening of analysis results from soil samples taken as part of investigations associated with the Luas Finglas Rail Project, Dublin, Ireland.

The Luas Finglas Rail Project includes two sections of construction that are understood to be near or adjacent to potentially infilled land, including a possible landfill site. These areas have been identified as St Helena's Road (North and South) and Tolka Valley Park, as presented in Figure 1-1. These areas shall be the focus of this assessment, however the remainder of the testing of the soils from along the proposed Luas route will also be screened. The site location plans and full proposed route of the rail project are included in Appendix A.

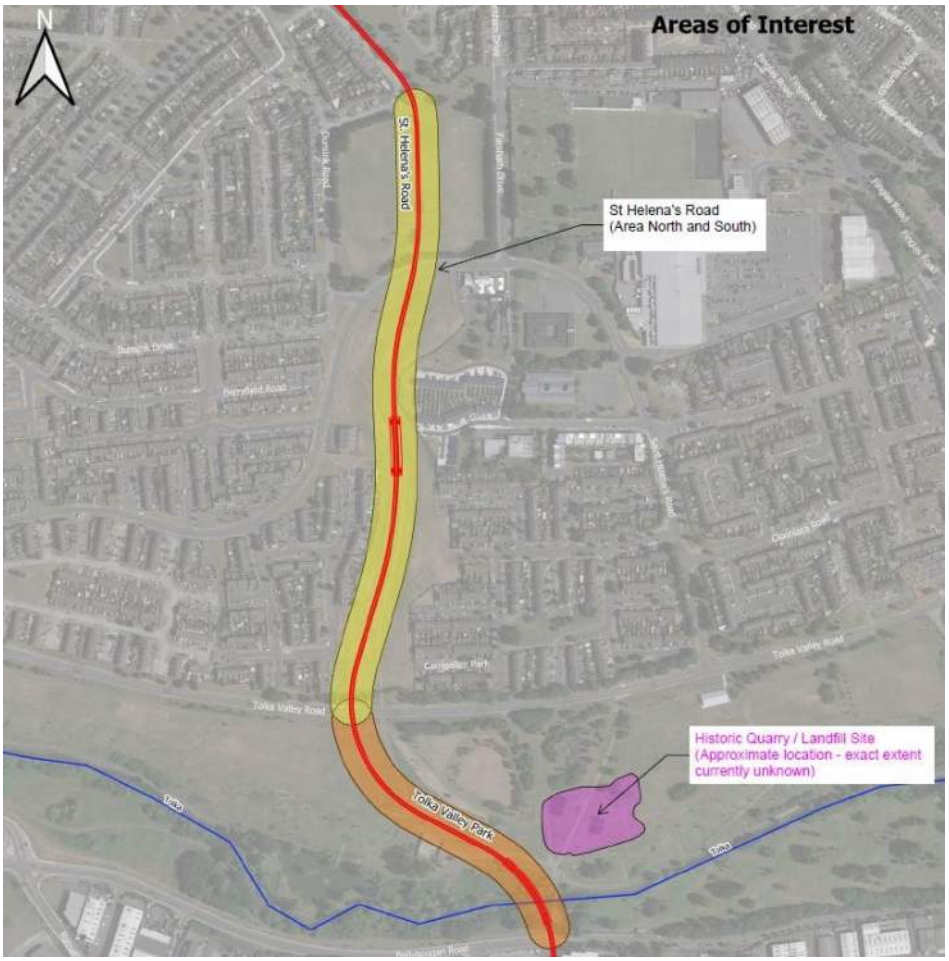

Figure 1-1 Areas of interest with regards potential contamination, highlighted in yellow and orange (JB Barry Drawing 2021)

1.2 Scope of Report

The scope of this report is as follows:

- Summarise the details of the ground investigation undertaken in relation to environmental investigation of the soils along the proposed Luas route,
- Present the ground conditions for the main geological units encountered across the area of interest,
- Present the geo-environmental soil testing results,
- Undertake a Generic Quantitative Risk Assessment and subsequently highlight any contaminants of concern,
- Recommend any remedial measures with regards to contamination within the soil, if required.
- Present the waste classification and Waste Acceptance Criteria to inform disposal, if required.

2 Ground Investigation

2.1 Field Work

A ground investigation was undertaken by Ground Investigation Ireland Ltd. between October 2021 to January 2022 in general accordance with IS EN 1997-2:2007, BS5930:2015 and BS10175:2011+A1:2013 and associated standards.

Along the proposed Luas route works comprised of:

- 21 No. Machine Excavated Trial Pits
- 35 No. Windowless Sample Boreholes
- 43 No. Cable Percussive Boreholes (42 No. with Rotary Core follow on)
- 3. No Rotary Core only Boreholes

Samples were taken from the trial pits, windowless samples, and the cable percussive phase for environmental testing.

A ground investigation plan showing the exploratory hole locations is provided in Appendix A. Logs for the investigation locations are included in Appendix B.

2.2 Sampling Strategy

Samples were taken at regular depths, changes in strata and any discrete horizons.

Samples scheduled for analysis of organic contaminants were inserted in amber bottles with little to no headspace. The bottles were then immediately sealed with polytetrafluoroethylene (PTFE) lined caps and labelled. The remaining small-disturbed samples were placed in polypropylene tubs with a

minimum of headspace, sealed with airtight polypropylene lids and labelled. The labels detailed individual sample number, location, depth, and sampler identity.

Collected samples were stored away from sunlight in temperature-controlled conditions and transported to Element Materials technology by courier. Chain of custody were completed for all samples sent off. The forms detailed individual bottle identification number and sample locations.

Two hundred and one disturbed soil samples were selected for laboratory analysis. The laboratory analyses scheduled were selected to establish the type, level and distribution of possible harmful contaminants that may be present on the site given its past and current uses.

2.2.1 Analysis Suite

Samples were tested for a broad range of possible contaminants, typically known as Suite E, as per the "Specification and related documents for Ground Investigation in Ireland". The suite includes:

- Heavy metals: arsenic, boron, cadmium, chromium (total), copper, lead, mercury, nickel, and zinc
- pH
- Water soluble sulphate (as SO_4)
- Organic matter
- Total Petroleum Hydrocarbons (TPHs)
- Polycyclic aromatic hydrocarbons (PAHs) – USEPA16
- Phenols
- Cyanide
- Asbestos

In addition to the Suite E determinands, GDG also requested analysis for:

- An extended heavy metals suite, including antimony, barium, beryllium, molybdenum, and selenium
- Polychlorinated Biphenyls (PCBs)
- BTEX
- Semi-volatile and Volatile Organic Compounds (SVOCS, VOCs)
- Chromium III and Chromium VI
- Total Organic Carbon
- Acid/alkali reserve
- Asbestos quantification (where asbestos was indicated during ID)

With regards the PCBs, BTEX, SVOCs and VOCs it was anticipated that these would be tested for in the event that evidence of this type of contamination was encountered during the works.

The suite will enable a full assessment of the geo-environmental ground conditions, and also allow a more appropriate assessment with regards hazardous properties when considering possible reuse, or less desirably, disposal to landfill.

3 Site Attendance

A GDG engineer attended site during the excavation of trial pits LF-TP-2010 and LF-TP-2011 in Tolka Valley Park. Photographs from this visit are included in Figure 3-2 to Figure 3-5, and the locations are highlighted in blue in Figure 3-1.

The engineer noted that at LF-TP-2010, a reworked clay with occasional brick fragments 2.6m thick (i.e., a cap) overlying Made Ground between 2.6m and the termination depth of 4.35m bgl. This Made Ground showed characteristics of landfill waste, with lots of plastic, shoes, magazines, and other domestic waste. A bad odour was noted, consistent with decomposing waste. The depth of the landfill material was not confirmed, as was restricted by the depth that the excavator could reach.

At LF-TP-2011, plastic waste was noted throughout the soils, with soil mixed with plastic bags and metal rebar. The material became more cohesive with depth, and a mudstone boulder or bedrock was identified at 3.2m bgl. No odours or evidence of obvious contamination was noted.

Figure 3-1 Tolka Valley Park Map Sheet 13. Blue indicates locations supervised by GDG

Figure 3-2 Overview of Tolka Valley Park, facing east

Figure 3-3 Overview of Tolka Valley Park, facing west from LF-TP 2011

Figure 3-4 Landfill Waste Excavated from LF-TP-2010

Figure 3-5 LF-TP-2011 Excavation. Visible sandy cap over landfill material

4 Ground Conditions

This section will summarise the ground conditions encountered within the previously identified areas where there was potential for contamination:

- Tolka Valley Park, Appendix A Map Sheet No.'s 13 to 15. Historic area of quarrying and landfill.
- St Helena's Road, Appendix A Map Sheet No.'s 10 to 13. Potential for landfill.

4.1 Tolka Valley Park

Nineteen exploratory hole locations considered for Tolka Valley Park are outlined in Table 4-1, the Site Investigation Plan can be found in Appendix A.

Table 4-1 Tolka Valley Park Exploratory Hole Locations

Map Sheet from SI Plan	Location ID
13	LF-TP-2010
13	LF-TP-2011
13	LF-WS-1018
13	LF-WS-1019
14	LF-WS-1020
14	LF-WS-1021
15	LF-WS-1022
13	LF-CPRC-1014
13	LF-CP-2010
13	LF-CPRC-2009
13	LF-CPRC-1017
13	LF-CPRC-1015
14	LF-CPRC-1016
14	LF-CPRC-2006
14	LF-CPRC-2007
15	LF-CPRC-1018
15	LF-RC1019
15	LF-CPRC-1020
15	LF-CPRC-1021

4.1.1 Made Ground

Most exploratory hole locations were overlain by Topsoil, which was generally described as slightly sandy and gravelly, which ranged in thickness between 0.20m and 0.30m. In locations LF-CPRC-1020 and LF-CPRC-1021 the Made Ground was overlain by 0.10m of tar road surfacing and location LF-WS-1022 was overlain by 0.15m of concrete.

The field logs do not clearly identify capping over the landfill materials described below, however the GDG supervising engineer observed that material likely to be a cap was present at both trial pits that were observed.

Made Ground consistent with domestic waste was encountered at all investigation locations at thicknesses between 0.75m and 5.55m.

Materials varied, dominantly comprising gravel and clay derived from various lithologies, brick and other waste materials. Concrete, slag, metal, plastic, glass, ceramic, tile, fabric, topsoil, wood, shells, charcoal, and tar. These materials are consistent with that of landfill waste. Boulders and cobbles were encountered locally.

With the deeper Cable Percussive and Rotary Coring borehole locations LF-CPRC-2009, LF-CPRC-1017, LF-CPRC-1015, LF-CPRC-1016 and LF-CPRC-2006, the Made Ground was found to be sitting directly at shallow depths of bedrock. Locations LF-CPRC-1015, LF-CPRC-1016, LF-CPRC-1017, LF-CPRC-2006 and LF-CPRC-2009 encountered Lucan Formation limestone at shallow depths between 1.6m bgl and 5.8m bgl.

4.1.2 Natural Deposits

A layer of Glacial Till (approximately 0.90m and 8.85m thick) of firm to very stiff slightly sandy gravelly clay was generally encountered at 8 of 19 investigation locations along the Tolka Valley Park region of the proposed Luas route. It was found to be firm to very stiff, slightly sandy, and slightly gravelly clay. With cobbles and boulders encountered locally.

At location LF-CPRC-1021 Alluvium was encountered at 11.45m bgl, of a thickness of 3.95m. The deposit consists of a succession of layers of sandy angular gravel of mixed lithology, overlying slightly clayey sand, over sandy clayey silt, on top of slightly gravelly silty clay.

4.1.3 Bedrock

Limestone bedrock belonging to the Lucan Formation was encountered at ten of the investigation points, as presented in Table 4-2.

Table 4-2 Depth to limestone bedrock

Map Sheet from SI Plan	Location ID	Bedrock Depth (m bgl)
13	LF-TP-2010	>4.5
13	LF-TP-2011	>3.2
13	LF-WS-1018	>4.0
13	LF-WS-1019	>1.7
14	LF-WS-1020	>1.2
14	LF-WS-1021	>1.0
15	LF-WS-1022	>1.7
13	LF-CPRC-1014	7.2
13	LF-CPRC-2010	>5.4

Map Sheet from SI Plan	Location ID	Bedrock Depth (m bgl)
13	LF-CPRC-2009	5.8 (weathered)
13	LF-CPRC-1017	1.6
13	LF-CPRC-1015	1.8 (weathered)
14	LF-CPRC-1016	3.5 (partially weathered)
14	LF-CPRC-2006	2.3
14	LF-CPRC-2007	5.0
15	LF-CPRC-1018	11.6
15	LF-RC-1019	10.65
15	LF-CPRC-1020	15.4
15	LF-CPRC-1021	>9.0

4.1.4 Ground Model

The Ground Model presented in Table 4-3 outlines the strata encountered during the intrusive site investigations in Tolka Valley Park.

Table 4-3 Tolka Valley Park Ground Model

Material Name	Typical Description	Depth (m bgl)	
		From	To
Superficial Geology			
Topsoil	Slightly sandy and gravelly topsoil	0.00	0.10-0.30
Made Ground	A combination of sandy, silty CLAY and GRAVEL. Comprised of a mixture of heterogenous material including red brick, plastic, plastic sheeting, glass, metal, ceramics, tar, mortar, fabric, slag, occasional plant fragments, charcoal, shells, gravel of limestone.	0.00-0.30	1.00-5.80
Glacial Till	Firm to very stiff slightly sandy, gravelly CLAY with some cobble and boulder fragments.	1.20-5.80	4.00-15.40
Bedrock			
Lucan Formation	Fine grained grey limestone, interbedded with a fine grained black mudstone.	1.60-15.40	-

4.2 St. Helena's Road

Twenty exploratory hole locations for the St Helena's Road proposed Luas route are outlined in Table 4-4, the Site Investigation Plan can be found in Appendix A.

Table 4-4 St Helena's Road Exploratory Hole Locations

Map Sheet from SI Plan	Location ID
10	LF-TP-2002
10	LF-TP-2003
10	LF-TP-2004
11	LF-TP-2005
12	LF-TP-2006
12	LF-TP-2007
12	LF-TP-2008
13	LF-TP-2009
10	LF-WS-1010
10	LF-WS-1011
10	LF-WS-1012
11	LF-WS-1013
11	LF-WS-1014
12	LF-WS-1016
12	LF-WS-1015
13	LF-WS-1017
11	LF-CPRC-1012
11	LF-CPRC-2004
12	LF-CPRC-1013
13	LF-CPRC-2005

4.2.1 Made Ground

Made Ground was encountered at all 20 exploratory hole locations at thickness between 0.5m and 5.7m. Slightly sandy and gravelly Topsoil was found to overlay the Made Ground at all locations at thicknesses between 0.1m and 0.4m. The Made Ground soils varied in composition, predominantly composed as a gravel or clay with heterogenous materials including red brick, concrete, metal plastic, timber, old topsoil and plant roots, ceramic, mortar fragments. Cobbles were encountered locally. This material is not deemed to represent domestic waste, as at Tolka Valley Park.

4.2.2 Natural Deposits

Glacial till was encountered at all but one location in the St Helena's Road investigation, firm to very stiff slightly sandy gravelly clay was encountered at depths between 0.70m bgl and 7.80m bgl, with thickness ranging from 0.3m and 9.4m.

A thin layer (approximately 0.6m to 1.9m thick) of Alluvium was encountered at three of 20 exploratory hole locations. Comprising of a succession of a medium to dense slightly silty sand and a clayey sandy fine to coarse gravel.

4.2.3 Bedrock

Limestone bedrock belonging to the Lucan Formation was encountered at 10.3m bgl at LF-CPRC-1012 and 17.2m bgl at LF-CPRC-2004 only.

4.2.4 Ground Model

The Ground Model found in Table 4-5 outlines the strata encountered during the intrusive site investigation in St Helena's Road area.

Table 4-5 St Helena's Road Ground Model

Material Name	Typical Description	Depth (m bgl)	
		From	To
Superficial Geology			
Topsoil	Slightly sandy and gravelly topsoil	0.00	0.10-0.40
Made Ground	A combination of sandy, silty CLAY and GRAVEL. Comprised of a mixture of heterogenous material including red brick, concrete, metal, tree roots, plastic bags, ceramic, wood, glass, mortar.	0.10-0.40	0.70-5.90
Glacial Till	Firm to very stiff slightly sandy, gravelly CLAY with some cobble and boulder fragments	0.70-7.80	3.00-17.20
Granular soil derived from limestone	Comprises of medium to dense slightly silty clayey fine to medium grained SAND and very clayey and sandy fine to coarse subangular to rounded GRAVEL with occasional cobbles and boulders.	3.90-5.90	4.50-7.80
Bedrock			
Lucan Formation	Fine grained grey limestone, interbedded with a fine grained black mudstone.	10.30-17.20	-

4.3 Evidence of Contamination

In addition to the evidence of landfill waste and Made Ground observed, localised evidence of hydrocarbon contamination was observed at one exploratory hole along the proposed Luas route (LF-CPRC-2010). Table 4-6 summarises the evidence of contamination encountered during the ground investigation.

Table 4-6 Exploratory Hole Location Contamination

Location ID	From (mBGL)	To(mBGL)	Lithology	Contamination
LF-CPRC-2010	3.00	4.20	Made Ground	Faint hydrocarbon odour
LF-CPRC-2011	Approx. 1.20	-	Made Ground	Visual identification of asbestos

The location of LF-CPRC-2010 is shown in Figure 4-1 and is in Tolka Valley Park which was previously identified to contain areas of historic landfill. The ground conditions of the borehole are summarised in Table 4-7. The borehole was terminated at 5.40m bgl due to refusal.

Table 4-7 LF-CPRC-2010 ground condition summary

Material Name	Typical Description	Depth (mBGL)	
		From	To
Topsoil	Slightly Gravelly	0	0.30
Made Ground	Slightly sandy gravelly clay with fragments of red brick, plastic, mortar, charcoal, shells, slag, glass, ceramic	0.30	4.20
Clay	Stiff and very stiff slightly sandy and gravelly clay with occasional subangular cobbles	4.20	-

The client has informed GDG that potential visual contamination of asbestos was observed by the drillers, in exploratory hole location LF-CPRC-2011 at 1.20m bgl. The location is out with the focus area of this report. No sample of the suspected material was collected to confirm the identification.

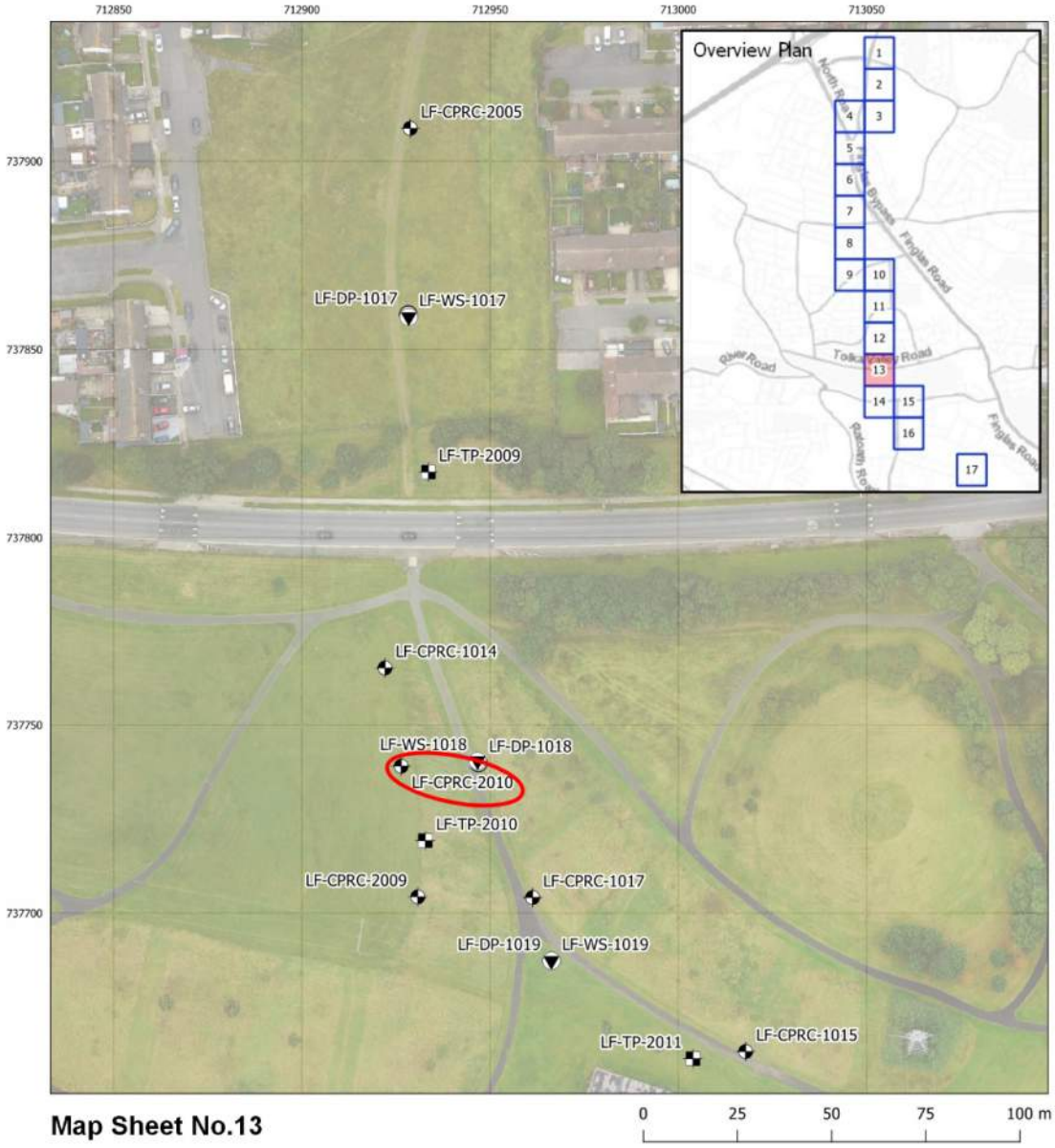

Figure 4-1 Tolka Valley Park Map Sheet 13. Red highlights location of LF-CPRC-2010

5 Generic Quantitative Risk Assessment

5.1 Soil Assessment Criteria

The risk from soil contamination is considered in the context of:

- Site users and future site users
- Construction workers
- Buried concrete

A Generic Quantitative Risk Assessment (GQRA) for human health was carried out by comparing contaminant concentrations against appropriate Generic Assessment Criteria (GAC). These have been generated to reflect risk scenarios including Public Open Space (Park), which is applicable in this project.

GAC's pertinent to the end use have been taken from Chartered Institute of Environmental Health (CIEH) /Land Quality Management (LQM) and Environmental Agency Soil Guideline Values (SGV) in accordance with Contaminated Land: Applications in Real Environments (CL:AIRE) sources.

The Organic Matter Content was found to range between 0.4% and 8.4% across the whole investigation area and GAC pertinent to this organic matter content was selected where appropriate. The average pH ranged between 7.29 and 10.76.

Risk of chemical attack on buried concrete will be assessed by comparing water soluble sulphate and pH levels in the soil with table C2 of BRE Special Digest 1:2005.

5.2 Statistical Analysis of Data

Where appropriate, chemical data for soils can be considered statistically in general accordance with the guidelines given in Chartered Institute of Environmental Health Publication *Guidance on Comparing Soil Contamination Data with a Critical Concentration* (May 2008).

5.3 Limitations

It should be noted that the interpretation of the results of the physical area is based on a limited number of investigation points and GDG did not supervise the works, with exception to two trial pits. The locations and numbers of the investigation locations are governed by cost-benefit, structure and accessibility etc. Although reasonable inferences will be made during the interpretation, variances in the distribution and physical/chemical characteristics of the strata present may exist between the investigation locations.

6 Results and Screening

Full results are provided in Appendix C and are summarised in Table 6-1 for determinands which were measured above the Limit of Detection (LOD). The Generic Assessment Criteria (GAC) threshold values, number of exceedances, and the number of tests are included in Table 6-1.

Table 6-1 Soil Test Results

Determinand	Maximum Determinand (mg/kg)	Generic Assessment Criteria (mg/kg)	Source	Number of exceedances
Heavy Metals				
Antimony	6.00	-	-	-(17)
Arsenic	38.00	170	S4UL 2015	0(147)
Barium	269.00	-	-	-(17)
Beryllium	3.60	63	S4UL 2015	0(137)
Cadmium	5.30	560	S4UL 2015	0(147)
Chromium (III)	82.50	8600	S4UL 2015	0(147)
Copper	375.00	44000	S4UL 2015	0(151)
Lead	401.00	Min: 580 Max: 1400	S4UL 2015	0(147)
Mercury	1.80	240	S4UL 2015	0(147)
Molybdenum	6.60	-	-	-(17)
Nickel	177.70	3400	S4UL 2015	0(147)
Selenium	5.00	1800	S4UL 2015	0(147)
Water Soluble Boron	2.90		-	-(137)
Zinc	469.00	17000	S4UL 2015	0(151)
Magnesium	3289.00	-	-	-(4)
Manganese	1581.00	-	-	-(6)
Phosphorus	1336.00	-	-	-(3)
Potassium	2156.00	-	-	-(4)
Other				
Asbestos	Chrysotile Fiber Bundles	Presence	HSA	2(147)
Sulphate (Water Soluble)	576.1 mg/l	500 mg / l	BRE SD1:2005	1(157)
Phenol	0.03	1500	S4UL 2015	0(136)
TPH				
Aliphatic >C8-C10 (HS_1D_AL)	1.80	18000	S4UL 2015	0(147)
Aliphatic >C10-C12 (EH_CU_1D_AL)	23.90	230000	S4UL 2015	0(147)
Aliphatic >C12-C16 (EH_CU_1D_AL)	140.00	25000	S4UL 2015	0(147)
Aliphatic >C16-C21 (EH_CU_1D_AL)	307.00	3800	S4UL 2015	0(147)
Aliphatic >C21-C35 (EH_CU_1D_AL)	609.00	3800	S4UL 2015	0(147)
Aliphatic >C35-C40 (EH_1D_AL)	26.00	250000	S4UL 2015	0(147)
Aliphatic >C6-C10 (HS_1D_AL)	1.10	-	S4UL 2015	-(11)
Aliphatic >C10-C25 (EH_1D_AL)	39.00	-	S4UL 2015	-(11)

Determinand	Maximum Determinand (mg/kg)	Generic Assessment Criteria (mg/kg)	Source	Number of exceedances
Aliphatic >C25-C35 (EH_1D_AL)	87.00	-	S4UL 2015	-(11)
Aromatic >EC8-EC10 (HS_1D_AR)	0.20	8500	S4UL 2015	0(147)
Aromatic >EC10-EC12 (EH_CU_1D_AR)	5.60	9700	S4UL 2015	0(147)
Aromatic >EC12-EC16 (EH_CU_1D_AR)	109.00	10000	S4UL 2015	0(147)
Aromatic >EC16-EC21 (EH_CU_1D_AR)	307.00	7700	S4UL 2015	0(147)
Aromatic >EC21-EC35 (EH_CU_1D_AR)	302.00	7800	S4UL 2015	0(147)
Aromatic >EC35-EC40 (EH_1D_AR)	130.00	7800	S4UL 2015	0(147)
Aromatic >EC6-EC10 (HS_1D_AR)	10.00	-	-	-(11)
Aromatic >EC10-EC25 (EH_1D_AR)	125.00	-	-	-(11)
Aromatic >EC25-EC35 (EH_1D_AR)	153.00	-	-	-(10)
PCBs				
PCB 28	0.016	-	-	-(76)
PCB 52	0.01	-	-	-(76)
PCB 101	0.036	-	-	-(76)
PCB 118	0.01	-	-	-(76)
PCB 138	0.077	-	-	-(76)
PCB 153	0.115	-	-	-(76)
PCB 180	0.138	-	-	-(76)
Monoaromatics & Oxygenates				
MTBE	0.078	-	-	-(180)
Benzene	0.023	11	S4UL 2015	0(180)
Toluene	0.043	95000	S4UL 2015	0(180)
Ethylbenzene	0.019	22000	S4UL 2015	0(180)
m/p-Xylene	0.036	-	S4UL 2015	-(180)
o-Xylene	0.02	24000	S4UL 2015	0(180)
PAHs				
Naphthalene	0.64	76.4 sol	S4UL 2015	0(178)
Acenaphthylene	0.55	30000	S4UL 2015	0(180)
Acenaphthene	1.86	30000	S4UL 2015	0(180)
Fluorene	1.55	20000	S4UL 2015	0(180)
Phenanthrene	11.53	6200	S4UL 2015	0(180)
Anthracene	2.53	150000	S4UL 2015	0(180)
Fluoranthene	9.57	6300	S4UL 2015	0(180)

Determinand	Maximum Determinand (mg/kg)	Generic Assessment Criteria (mg/kg)	Source	Number of exceedances
Pyrene	8.96	15000	S4UL 2015	0(180)
Benzo(a)anthracene	4.64	56	S4UL 2015	0(180)
Chrysene	4.68	110	S4UL 2015	0(180)
Benzo(bk)fluoranthene	8.98	-	-	-(180)
Benzo(a)pyrene	5.21	12	S4UL 2015	0(180)
Indeno(123cd)pyrene	3.27	170	S4UL 2015	0(180)
Dibenzo(ah)anthracene	0.75	-	-	-(180)
Benzo(ghi)perylene	3.03	1500	S4UL 2015	0(175)
Coronene	0.47	-	-	0(180)
Benzo(b)fluoranthene	6.47	1500	S4UL 2015	0(180)
Benzo(k)fluoranthene	2.51	15	S4UL 2015	0(180)
Benzo(j)fluoranthene	125.00	410	S4UL 2015	0(33)
VOC MS				
Dichloromethane (DCM)	0.024	-	-	-(18)
Toluene	0.008	95000	S4UL 2015	0(18)
Tetrachloroethene (PCE)	0.055	-	-	-(18)
Chlorobenzene	0.004	2000	S4UL 2015	0(18)
Ethylbenzene	0.007	22000	S4UL 2015	0(18)
m/p-Xylene	0.009	-	-	-(18)
1,3,5-Trimethylbenzene	0.023	-	-	-(18)
1,2,4-Trimethylbenzene	0.048	-	-	-(18)
sec-Butylbenzene	0.01	-	-	-(18)
4-Isopropyltoluene	0.049	-	-	-(18)
n-Butylbenzene	0.01	-	-	-(18)
Naphthalene	0.054	76.4 sol	-	0(18)
SVOC MS				
4-Methylphenol	0.106	-	-	-(18)
Carbazole	0.094	-	-	-(18)
Dibenzofuran #	0.09	-	-	-(18)
Bis(2-ethylhexyl) phthalate	1.599	-	-	-(18)
Di-n-Octyl phthalate	0.122	-	-	-(18)
Diethyl phthalate	0.1	-	-	-(18)

When screening the results, the following determinands were tested for but results showed that these were all below the limit of detection:

VOC MS

- Dichlorodifluoromethane
- Methyl Tertiary Butyl Ether
- Chloromethane
- Vinyl Chloride
- Bromomethane
- Chloroethane
- Trichlorofluoromethane
- 1,1-Dichloroethene (1,1 DCE)
- trans-1-2-Dichloroethene
- 1,1-Dichloroethane
- cis-1-2-Dichloroethene
- 2,2-Dichloropropane
- Bromochloromethane
- Chloroform
- 1,1,1-Trichloroethane
- 1,1-Dichloropropene
- Carbon tetrachloride
- 1,2-Dichloroethane
- Benzene
- Trichloroethene (TCE)
- 1,2-Dichloropropane
- Dibromomethane
- Bromodichloromethane
- cis-1-3-Dichloropropene
- trans-1-3-Dichloropropene
- 1,1,2-Trichloroethane
- 1,3-Dichloropropane
- Dibromochloromethane
- 1,2-Dibromoethane
- 1,1,1,2-Tetrachloroethane
- o-Xylene
- Styrene
- Bromoform
- Isopropylbenzene
- 1,1,2,2-Tetrachloroethane
- Bromobenzene
- 1,2,3-Trichloropropane
- Propylbenzene
- 2-Chlorotoluene
- 4-Chlorotoluene
- tert-Butylbenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- 1,2-Dibromo-3-chloropropane
- 1,2,4-Trichlorobenzene
- Hexachlorobutadiene
- 1,2,3-Trichlorobenzene

SVOC

- 2-Chlorophenol
- 2-Methylphenol
- 2-Nitrophenol
- 2,4-Dichlorophenol
- 2,4-Dimethylphenol
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol
- 4-Chloro-3-methylphenol
- 4-Nitrophenol
- Pentachlorophenol

Other SVOCs

- 1,2-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 2-Nitroaniline
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- 3-Nitroaniline
- 4-Bromophenylphenylether
- 4-Chloroaniline
- 4-Chlorophenylphenylether
- 4-Nitroaniline
- Azobenzene
- Bis(2-chloroethoxy)methane
- Bis(2-chloroethyl)ether
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Hexachloroethane
- Isophorone
- N-nitrosodi-n-propylamine
- Nitrobenzene

TPH

- Aliphatic >C5-C6 (HS_1D_AL)
- Aliphatic >C6-C8 (HS_1D_AL)
- Aromatics >C5-EC7 (HS_1D_AR)
- Aromatics >EC7-EC8 (HS_1D_AR)

PAHs

- 2-Chlorophthalene

6.1 Discussion of Results

6.1.1 Human Health – End User & Construction Workers

As the receptor is human health the principle pathways of concern are:

- Dermal contact,
- Ingestion, and
- Inhalation.

Generally, in the assessment for future site users, only samples taken from the top 1.0m are considered, as contact with deeper samples is highly unlikely.

Risks to construction and maintenance workers are considered as part of the exposure assessment although the GAC typically only apply to the protection of health for long-term chronic exposure. Construction workers are more likely to be at risk from a high single exposure, i.e., an acute dose, which can result in contamination poisoning.

Reviewing Table 6-1 which screens the broad range of the broad range of contaminants against the GAC, there are no significant or harmful levels of heavy metal, SVOCs or TPH contamination with regards to the conservative Public Open Space (Park) GQRA Generic Assessment Criteria. With regards to soil screening for human health, the majority of determinands were found to be at levels that would not be harmful.

Asbestos was detected at two locations during laboratory analysis, it was potentially visually identified at exploratory hole location LF-RC-2011, there is no laboratory analysis to confirm. Olfactory evidence of hydrocarbon contamination was encountered at a single location noted in the field notes, which is discussed in the following sections. The GDG site engineer observed a waste odour whilst supervising exploratory hole locations LF-TP-2010 and LF-TP-2011.

6.1.1.1 Asbestos

Chrysotile was identified as fiber bundles within two samples in two different exploratory hole locations LF-CPRC-2010 and LF-TP-3001, both at 0.5m bgl. Quantification of the asbestos has shown that the amount of asbestos accounts for <0.1% in both samples.

Location LF-CPRC-2010 ground conditions have been discussed previously in Section 4.2 and is in Tolka Valley Park. At 0.5m bgl strata in the field log is described as “dark brown slightly sandy slightly gravelly clay with occasional fragments of red brick”.

Location LF-TP-3001 (Map 17) strata at 0.5m bgl is described in the field log as “slightly sandy and gravelly clay with many red brick and plastic fragments”. This location is out-with the Tolka Valley Park and St Helena’s Roads sections, although at this depth and on the basis that asbestos is not widespread the risk to future site users is negligible.

Construction workers should be briefed on the possible presence of localised asbestos. Contact with soils should be avoided wherever possible and appropriate training and Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) be provided to mitigate the risk of inhalation of asbestos.

6.1.1.2 Evidence of Contamination

As described in Section 4.1.1 and Section 3.6, evidence of contamination was encountered during the site investigation works.

The presence of domestic waste materials in the ground at Tolka Valley Park was identified.

In LF-TP-2010 in the Tolka Valley Park, olfactory evidence of hydrocarbons was encountered, the thickness of the product was not measurable and indicative of minor impact form residual hydrocarbons in soils in the area rather than the presence of significant impact. Test results confirm this, results did not show levels of PAH or TPH that exceeded the GQRA Public Open Space (Park) screening values. The risk to future site users is therefore considered to be very low.

Potential asbestos containing material (ACM) was observed by the drillers in exploratory hole location LF-CPRC-2011 at 1.20m bgl. The location is out with the focus area of this report. No sample of the suspected material was collected to confirm the identification. This ACM is considered to be sufficiently deep so that there is negligible risk to site users and increased risk to construction workers in the case where soils are disturbed.

Appropriate mitigation measures (avoid contact with soils, appropriate training, appropriate PPE and RPE) will reduce the risk to construction workers during development of the tramline.

6.1.2 Building, Structures & Services

6.1.2.1 Aggressive Ground

Along the Luas route, soluble sulphate at the investigation points was found to be less than 500mg/l with exception to one location, LF-CPRC-1022. This is located in the Tolka Valley Park region. At a depth of 2.0m bgl the water-soluble sulphate exceeded the screening value of 500 mg/l with a value of 576.1 mg/l. This is a marginal exceedance of the BRE Special Digest 1:2005 criteira. At the location at 2.0m bgl the stratigraphy is described in the field notes as possible Made Ground “Stiff brown sandy slightly gravelly clay with frequent subangular cobbles”.

The average pH ranged between 7.29 and 10.76.

On the basis that soluble sulphate was <500mg/l and pH was >6.5 along the majority of the route, a design sulphate class of DS-1 and ACEC Class of AC-1 is likely to be adequate. The structural designer may consider increasing the design sulphate and ACEC class of concrete local to LF-CPRC-1022 (2.0m bgl).

7 Conceptual Site Model

The environmental risks associated with the existing and historic uses of the site have been reviewed, and a site investigation undertaken with geo-environmental analysis of soils. This allows an assessment in the form of a Conceptual Site Model (CSM) to be undertaken.

A CSM identifies the potential sources of contamination and potential pathways that these may use, ultimately ending in the impact of a receptor. The receptors are determined by identifying the proposed end use of the site.

7.1 Sources

- **S1: Contamination from Made Ground on-site –** the previous use of the site, including the use of a historic quarry as a landfill. Screening of soil analysis data against Generic Assessment Criteria (GAC) for Public Open Space (Park) has not identified exceedances in any of the 201 samples selected for analysis, with exception to 2 localised instances of asbestos (<0.1%) at 0.5m bgl and one potential identification at 1.20m bgl.
- **S2: Aggressive ground conditions** associated with elevated sulphate / acidic ground conditions. Soluble sulphate levels were found to be <500mg/l in all but one of the 154 samples tested. pH was above 5.5 in all samples.

7.2 Receptors

Review of historic data has identified the following potential receptors:

- **R1: Human Health** – The risk to human health during the construction phase and end-use as a tram line and public park.
- **R2: Building, Structures & Services –** Permanent structures are proposed in the formation of the tramline.

7.3 Pathways

Pathways that may be present on this site, following development include:

- **P1:** Direct contact, ingestion, and inhalation of gas and dust, including asbestos
- **P2:** Chemical attack on buried concrete associated with aggressive ground conditions

7.4 Source-Pathway-Receptor Linkages

Figure 7-1 to Figure 7-2 present the Source-Pathway-Receptor linkages (S-P-R) considered for St. Helena's Road and Tolka Valley Park.

7.4.1 S-P-R Human Health

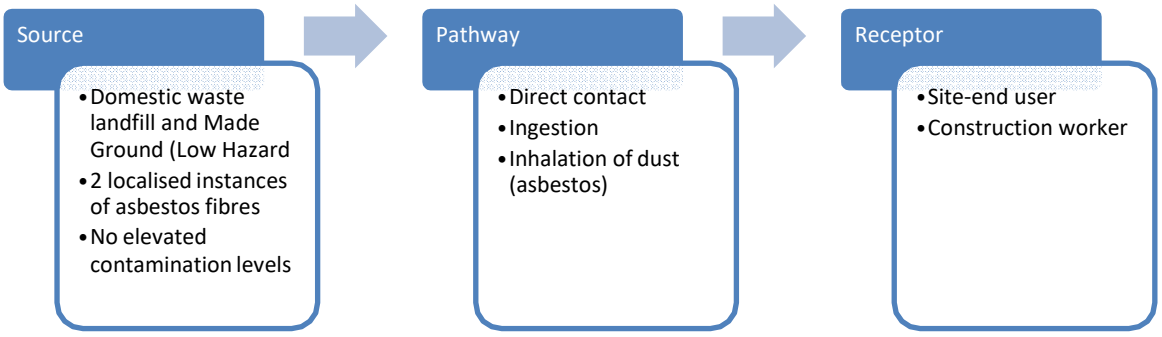

Figure 7-1 S-P-R linkage for human health

7.4.1.1 Risk Assessment

Landfill materials consistent with domestic waste were encountered in the Tolka Valley Park investigation locations, with localised instances of olfactory evidence of contamination. No visual evidence of hydrocarbon contamination or asbestos was described in the field logs. Screening against the GAC for human health (Public Open Space – Park) indicates that the soils are unlikely to pose a risk to the future end user. One instance of asbestos in the Tolka Valley Park region was identified at 0.5mbgl, and another instance was encountered in the south-east portion of the Luas route. This is considered to pose a very low risk to the end user on the basis that asbestos in the materials is not pervasive, and exposure to this material is extremely unlikely.

Soils along the St Helena's Road route did not exhibit any evidence of contamination or landfill materials. Made Ground was present; however no GAC were exceeded for the human health Public Open Space – Park scenario. The risk of exposure to contaminants of concern to future end user is considered negligible.

It is considered that the risk construction workers will be managed by the contractor, with appropriate training and adequate PPE provided when direct material handling cannot be avoided.

7.4.2 S-P-R Aggressive ground

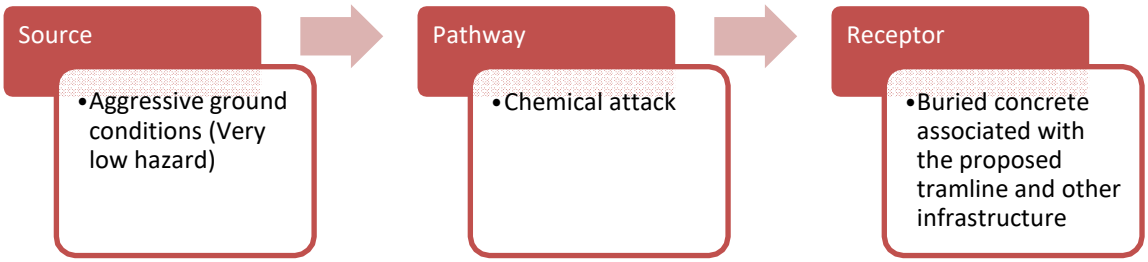

Figure 7-2 S-P-R linkage for built environment

7.4.2.1 Risk Assessment

The likelihood of chemical attack on buried concrete along the proposed tram route is considered to be very low following soluble sulphate and pH testing of soils and Made Ground. The structural designer is to confirm the appropriate concrete class, however at this time DS-1 ACEC-1 is considered likely to be sufficient.

8 Material Reuse & Disposal

8.1 Material Reuse

Circular economy and material re-use are key aspects of the Luas Finglas design brief.

The analysis of soils in Tolka Valley Park and the St Helena's Road section, and screening against the GAC for human health, has indicated that the Made Ground and shallow soils along the route of the proposed Luas route are not harmful and are therefore suitable for reuse from an environmental perspective. Screening may need to be undertaken to make soils reusable from a geotechnical perspective, however.

The landfill waste material in Tolka Valley Park unlikely to be viable for reuse due to the nature of the waste and would require disposal to landfill.

Ultimately, the contractor and supervising engineer shall be responsible for segregating and screening soils to determine which material is suitable for reuse, using best practice. Where domestic waste is excavated within the Tolka Valley Park region, it is likely that these materials will need to be disposed of, although the contractor may use discretion with regards ground condition and screen where deemed appropriate with aim to reducing disposal volume as much as practicable.

Where unidentified contamination (such as potential asbestos containing material or free phase hydrocarbon product) is encountered, material should be segregated and stockpiled on a low permeability surface with bunding and be covered to allow further testing of the impacted soils to enable specification of treatment and reuse, or disposal.

8.2 Material Disposal

Table 8-1 shows a summary of the WAC and waste classification and the likely Waste Category with regards Irish Landfill Acceptance Criteria, as defined by EU Council Decision 2003/33/EC of establishing criteria for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1991/31/EC (Landfill Directive). These criteria are included in Appendix F for reference.

WAC testing and waste classification testing are both required to enable assessment of Waste Category B1 and above, therefore it is not possible to provide a classification for all samples in this regard.

8.2.1 Waste Classification

Sixty eight soil samples and fourteen samples deemed representative of likely municipal waste were taken during the site investigations and tested for a broad range of contaminants including heavy metals and organics. The samples have been taken along the entire proposed route, i.e. we have included all samples, not just the St Helena's Road and Tolka Valley Park samples.

Results of the testing are included in Appendix C and a summary table is provided in Table 8-1.

Following receipt of results all materials were classified (hazardous / non-hazardous) via the Hazwasteonline tool (https://www.hazwasteonline.com/) which is compliant with the Environment Agency WM3 v1.1 guidance.

It is considered that the soils would be classified as 17 05 04 (Soil and stones other than those mentioned in 17 05 03) in the List of Waste, even in the case of the municipal waste. However, for ease of reference, two waste classification reports have been generated, one for non-municipal waste soils, and one for soils that were deemed likely to be municipal waste in the Tolka Valley Park area. The waste classification reports are included in Appendix D.

All samples analysed have been found to be Non-Hazardous.

If soils are to be excavated and disposed off-site, it is recommended that the waste classification data be included in the development of a detailed soil management plan.

8.2.2 Waste Acceptance Criteria

Sixty-six laboratory certificates from the Waste Acceptance Criteria (WAC) testing are included in Appendix E and summarised in Table 8-1. This assessment of the soils is forindicative purposes only. Soils are indicated to be predominantly Inert, however WAC certificatesshould be provided to the receiving landfill to determine the classification, as there may be localdifferences in criteria.

Soils designated for disposal should be tested prior to disposal to confirm their WAC classification and disposed of in accordance with industry guidance. It is recognised that Irish landfills do not generally accept soils with trace asbestos.

Table 8-1 WAC, Waste Classification & Waste Category

Location ID	Depth (m BGL)	Anthropogenic materials present?**	Landfill area?	WAC	Waste Classification	Waste Category
LF-CPRC-1001	**1.00**			Inert	-	A
LF-CPRC-1003	**0.50**			Inert	Non Hazardous	B1
LF-CPRC-1004	**1.00**			Inert	-	A
LF-CPRC-1004	**0.50**			-	Non Hazardous	A

Location ID	Depth (m BGL)	Anthropogenic materials present?**	Landfill area?	WAC	Waste Classification	Waste Category
LF-CPRC-1004	2.00			-	Non Hazardous	A
LF-CPRC-1005	0.50	✓		Inert	-	N/A
LF-CPRC-1005	1.00			-	Non Hazardous	A
LF-CPRC-1006	0.50	✓		Inert	Non Hazardous	B1
LF-CPRC-1006	1.00	✓		-	Non Hazardous	N/A
LF-CPRC-1007	0.50	✓		Inert	-	N/A
LF-CPRC-1009	0.50			Inert	-	A
LF-CPRC-1010	0.50	✓		Inert	-	N/A
LF-CPRC-1012	0.50	✓		-	Non Hazardous	N/A
LF-CPRC-1014	1.00	✓	✓	-	Non Hazardous	N/A
LF-CPRC-1014	3.00	✓	✓	Inert	-	N/A
LF-CPRC-1014	0.50	✓	✓	-	Non Hazardous	N/A
LF-CPRC-1014	2.00	✓	✓	-	Non Hazardous	N/A
LF-CPRC-1014	4.00	✓	✓	-	Non Hazardous	N/A
LF-CPRC-1014	5.00		✓	-	Non Hazardous	A
LF-CPRC-1017	0.50	✓	✓	Inert	Non Hazardous	B1
LF-CPRC-1017	1.70		✓	-	Non Hazardous	A
LF-CPRC-1018	2.00	✓	✓	Inert	-	N/A
LF-CPRC-1018	3.00	✓	✓	-	Non Hazardous	N/A
LF-CPRC-1018	4.00	✓	✓	-	Non Hazardous	N/A
LF-CPRC-1018	3.00	✓		-	Non Hazardous	N/A
LF-CPRC-1020	1.00	✓		Inert	-	N/A
LF-CPRC-1020	0.50	✓		-	Non Hazardous	N/A

Location ID	Depth (m BGL)	Anthropogenic materials present?**	Landfill area?	WAC	Waste Classification	Waste Category
LF-CPRC-1020	2.00			-	Non Hazardous	A
LF-CPRC-1021	0.40	✓		Inert	-	N/A
LF-CPRC-1021	1.20	✓		-	Non Hazardous	N/A
LF-CPRC-1022	1.00			Inert	-	A
LF-CPRC-1022	3.00			Inert	Non Hazardous	A
LF-CPRC-1022	2.00			-	Non Hazardous	A
LF-CPRC-1024	1.00			Inert	-	A
LF-CPRC-1024	2.00			-	Non Hazardous	A
LF-CPRC-1027	1.00			Non Hazardous	Non Hazardous	C
LF-CPRC-1028	0.50	✓		Inert	-	N/A
LF-CPRC-1028	1.00	✓		-	Non Hazardous	N/A
LF-CPRC-1031	2.00	✓		Inert*	-	N/A
LF-CPRC-1031	2.60			-	Non Hazardous	A
LF-CPRC-1032	3.00			-	Non Hazardous	A
LF-CPRC-2003	0.50	✓		Inert	-	N/A
LF-CPRC-2003	2.00			-	Non Hazardous	A
LF-CPRC-2005	2.00	✓		Hazardous	-	N/A
LF-CPRC-2006	0.50		✓	Inert	-	A
LF-CPRC-2010	2.00	✓	✓	Inert	Non Hazardous	B1
LF-CPRC-2010	4.00	✓	✓	Inert	Non Hazardous	B1
LF-CPRC-2010	0.50	✓	✓	-	Non Hazardous	N/A
LF-CPRC-2010	1.00		✓	-	Non Hazardous	A
LF-CPRC-2010	5.00		✓	-	Non Hazardous	A

Location ID	Depth (m BGL)	Anthropogenic materials present?**	Landfill area?	WAC	Waste Classification	Waste Category
LF-CPRC-2011	0.50	✓		-	Non Hazardous	N/A
LF-CPRC-2011	1.00	✓		-	Non Hazardous	N/A
LF-CPRC-2012	1.00	✓		-	Non Hazardous	N/A
LF-CPRC-3002	1.00	✓		-	Non Hazardous	N/A
LF-CPRC-1023	0.50	✓		-	Non Hazardous	N/A
LF-TP-1004	1.00			Inert	Non Hazardous	A
LF-TP-1005	1.00			-	Non Hazardous	A
LF-TP-1006	0.50			Inert	-	A
LF-TP-1007	1.00	✓		Inert	-	N/A
LF-TP-1008	0.50			-	Non Hazardous	A
LF-TP-2001	0.50	✓		Inert	Non Hazardous	B1
LF-TP-2001	1.00			-	Non Hazardous	A
LF-TP-2002	1.00			-	Non Hazardous	A
LF-TP-2003	0.50	✓		-	Non Hazardous	N/A
LF-TP-2003	1.00			-	Non Hazardous	A
LF-TP-2004	1.00			Inert	-	A
LF-TP-2005	0.50	✓		-	Non Hazardous	N/A
LF-TP-2005	1.00	✓		-	Non Hazardous	N/A
LF-TP-2005	3.00			-	Non Hazardous	A
LF-TP-2006	1.00			Inert	-	A
LF-TP-2007	1.00	✓		Inert	-	N/A
LF-TP-2007	3.00	✓		Inert*	-	N/A
LF-TP-2008	2.00	✓		Inert	-	N/A
LF-TP-2008	4.00			Inert	-	A
LF-TP-2009	0.50	✓		Inert	-	N/A
LF-TP-2009	1.00	✓		-	Non Hazardous	N/A
LF-TP-2009	3.00	✓		-	Non Hazardous	N/A

Location ID	Depth (m BGL)	Anthropogenic materials present?**	Landfill area?	WAC	Waste Classification	Waste Category
LF-TP-2010	**1.00**	✓	✓	Inert	-	N/A
LF-TP-2010	**3.00**	✓	✓	Inert	-	N/A
LF-TP-2011	**0.50**	✓	✓	Inert	-	N/A
LF-TP-2011	**3.00**	✓	✓	Inert	-	N/A
LF-TP-3001	**1.00**	✓		Inert	-	N/A
LF-TP-3001	**0.50**	✓		-	Non Hazardous	N/A
LF-TP-3001	**2.00**			-	Non Hazardous	A
LF-TP-3002	**2.00**			-	Non Hazardous	A
LF-WS-1001	**0.50**			Inert	Non Hazardous	B1
LF-WS-1003	**1.00**			-	Non Hazardous	N/A
LF-WS-1004	**0.50**	**N/A**		-	Non Hazardous	N/A
LF-WS-1005	**1.00**			Inert	-	A
LF-WS-1005	**0.50**			-	Non Hazardous	A
LF-WS-1006	**0.50**	✓		Inert	Non Hazardous	B1
LF-WS-1007	**1.00**			Inert	-	A
LF-WS-1007	**0.50**	✓		-	Non Hazardous	N/A
LF-WS-1007	**1.50**	✓		-	Non Hazardous	N/A
LF-WS-1007	**2.50**	✓		-	Non Hazardous	N/A
LF-WS-1008	**0.50**			-	Non Hazardous	N/A
LF-WS-1010	**2.00**			-	Non Hazardous	A
LF-WS-1011	**0.50**	✓		-	Non Hazardous	N/A
LF-WS-1012	**0.50**	✓		Inert	Non Hazardous	B1
LF-WS-1012	**1.20-1.70**			-	Non Hazardous	A
LF-WS-1013	**1.20-1.90**	✓		-	Non Hazardous	N/A
LF-WS-1013	**2.80-3.00**	✓		-	Non Hazardous	N/A

Location ID	Depth (m BGL)	Anthropogenic materials present?**	Landfill area?	WAC	Waste Classification	Waste Category
LF-WS-1018	**1.00**	✓	✓	Inert	-	N/A
LF-WS-1022	**1.40**	✓		-	Non Hazardous	N/A
LF-WS-1023	**0.10-1.10**	✓		Inert	-	N/A
LF-WS-1023	**0.10**	✓		-	Non Hazardous	N/A
LF-WS-2002	**0.50**	✓		Inert	-	N/A
LF-WS-2006	**1.00**			-	Non Hazardous	N/A
LF-WS-2007	**0.50**	**N/A**		Inert	-	N/A
LF-WS-2007	**1.00**	**N/A**		-	Non Hazardous	N/A
LF-WS-2008	**0.50**			-	Non Hazardous	N/A
LF-WS-2010	**1.00**	✓		Inert	-	N/A
LF-WS-2010	**0.50**	✓		-	Non Hazardous	N/A
LF-WS-2010	**1.50**			-	Non Hazardous	A
LF-WS-2010	**2.50**	✓		-	Non Hazardous	N/A
LF-WS-2011	**0.50-1.00**	✓		Inert	Non Hazardous	B1
LF-WS-3002	**1.00**	✓		Inert	Non Hazardous	C

* Inert Landfill - Increased Limits from IMS Hollywood Landfill Acceptance Criteria
** According to field logs

9 Conclusions and Recommendations

GDG have been provided with the field logs, locations, and environmental analysis data to review and assess with regards environmental risks posed to human health and the structures associated with the proposed Luas tram extension route through Tolka Valley Park and St Helena's Road.

Ground Investigation Ireland Ltd. (GII) carried out site investigations between October 2021 to January 2022. GDG attended the site investigation observing the investigation of LF-TP-2010 and LF-TP-2011 in the Tolka Valley region.

Domestic landfill waste was identified in the Tolka Valley region. Made Ground was encountered along St. Helena's Road however is not consistent with a landfill waste. Thickness of the landfill and Made Ground was found to be up to 5.7m. There was no visual evidence of hydrocarbon or asbestos contamination, and localised instances of hydrocarbon / waste odours, in the Tolka Valley Park area only.

Soil samples were collected by GII and scheduled for geoenvironmental analysis with assistance from GDG. GDG have analysed the results and a GQRA has been completed.

Soils were tested for a broad suite of contaminants including asbestos, hydrocarbons, and chlorinated solvents. Elevated levels of heavy metals, TPH, PAH, PCB, VOC and SVOCs were identified in the soils. However, screening of the results has shown no exceedances against the industry criteria for human health in a Public Open Space (Park) scenario, indicating that the soils at shallow depth along the proposed Luas route are unlikely to pose a risk to the future end user.

Asbestos was encountered at 2 of 144 samples tested. One instance was identified at 0.5mbgl at <0.1% in Tolka Valley Park, whilst the other was at the same depth and concentration in the south-east portion (Map 17) of the Luas route. This poses a very low risk to the future end user as exposure to these soils is considered extremely unlikely. Potential asbestos containing material (ACM) was encountered out-with the focus area of this report, however the material was encountered at 1.2m bgl, and therefore poses a negligible risk to site users.

Construction works should be undertaken in a manner to avoid contact between construction workers and ground material wherever possible. Where contact is absolutely necessary, staff should be trained in dealing with contaminated land and equipped with appropriate PPE and/or RPE to ensure that risk to health remains low.

Across the whole site, ground conditions have not been found to be aggressive with regards buried concrete, based on the analysis of soils to data. Final concrete design should be confirmed by the structural designer.

With exception to existing landfill waste, shallow soils on site indicated to be suitable for reuse from an environmental perspective as no GAC were exceeded during the laboratory analysis, however screening may be required in order to enable reuse of the Made Ground materials to remove components such as brick, metal, plastic, etc.

Waste classification of the available data indicates that soils are Non-Hazardous, whilst WAC testing has shown soils are predominantly Inert, with one instance of Non-Hazardous and one instance of Hazardous materials. The waste classification report and WAC certificates pertinent to those soils being disposed of should be provided to the receiving landfill prior to disposal to ensure that they will accept the waste. Depending on the volume of soils that require to be disposed of, further testing may be required to meet the receiving landfill test frequency requirements.

References

British Standards Institute (2011). Investigation of potentially contaminated sites. Code of practice. British Standards Institute publication BS 10175:2011+A2:2017

British Standards Institute (2015) Code of practice for site investigations. British Standards Institute publication BS 5930:2015

British Standards Institution (2004). B.S.-EN 1997-1:2004 -Eurocode 7: Geotechnical design: Part 1: General Rules. London, British Standards Institution. (Including British National Annex 2004)

Building Research Establishment Special Digest 1 (2005). Concrete in aggressive ground, 3rd Ed. Building Research Establishment Construction Division, UK

Contaminated Land: Applications in Real Environments (2010). Soil Generic Assessment Criteria for Human Health Risk Assessment.

Environment Agency (2009). Soil Guideline Values for [arsenic, cadmium, nickel, mercury, selenium, phenol, benzene, ethylbenzene, toluene, xylene] in soil. Science Report SC050021 [arsenic, cadmium, nickel, mercury, selenium, phenol, benzene, ethylbenzene, toluene, xylene] SGV

Environment Agency WM3 Technical Guidance: Guidance on the classification and assessment of waste, v1.1.NI

Health and Safety Executive (2012). Asbestos: the survey guide. HSG264 (second edition)

Land Quality Management/Chartered Institute of Environmental Health (2015). Suitable 4 Use Levels for Human Health Risk Assessment. Land Quality Press publication.

Statutory Instrument No. 386/2006 - Safety, Health and Welfare at Work (Exposure to Asbestos) Regulations 2006

Appendices

Due to the extensive size of the appendices attached to this report and in the interest of promoting environmental sustainability, the Luas Team has decided not to produce printed copies of the full report. However, the report is available for review on the Luas Finglas website at www.luasfinglasro.ie."

Offices

Dublin (Head Office)
Gavin & Doherty Geosolutions
Unit A2, Nutgrove Office Park
Rathfarnham
Dublin 14, D14 X627
Phone: +353 1 207 1000

Cork
Gavin & Doherty Geosolutions
Unit 4E, Northpoint House,
North Point Business Park
Cork, T23 AT2P
Phone: +353 21 237 3434

London
Gavin & Doherty Geosolutions (UK) Limited
Floor 33 Euston Tower
286 Euston Road,
London, NW1 3DP
Phone: +44 203 463 8626

Edinburgh
Gavin & Doherty Geosolutions (UK) Limited
21 Young Street
Edinburgh
Scotland, EH2 4HU
Phone: +44 1 313 444 605

Belfast
Gavin & Doherty Geosolutions (UK) Limited
Scottish Provident Building
7 Donegall Square West
Belfast, BT1 6JH
Phone: +44 289 091 8845

Website: www.gdgeo.com
Email: info@gdgeo.com

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Údarás Náisiúnta Iompair
National Transport Authority

BARRY TRANSPORTATION
egis GROUP

egis

Project Ireland 2040
Building Ireland's Future